1. Purpose of Experiments
   Include immediate goal of the experiments, scientific importance and/or programmatic relevance. Refer to any relevant program milestones.

   Determine parameter range over which different H-mode regimes occur. The regimes would include ELMfree, EDA, type II, III ELMs (type I if obtainable) and the parameter range would be characterized in both engineering and local plasma physics variables. Scaling information for pedestal width and height will also be obtained.

2. Background
   Discuss Physics basis of the proposed research, Prior results at Alcator or elsewhere, and any related work being carried out separately.

   The standard operating regime for burning plasma experiments will require operation with large pedestals but without large ELMs. While a number of regimes which meet these criteria have been identified in the current generation of experiments, it is not clear how they extrapolate into the reactor regime. The point of this proposal is to generate data required to develop physics models which would allow that extrapolation.

   Previous experiments have explored the EDA/ELMfree boundary and found strong dependence on $q$ and $\delta$. Other studies have found a boundary between EDA and type II ELMs at high $\beta$ (or $\alpha$) and high temperature. In particular we will exploit the increased shaping and increased RF power available during this campaign.

3. Approach
   Describe the methodology to be employed; explain the rationale for the choice of parameters, etc. Describe the analysis techniques to be employed in interpreting the data, if applicable. If the approach is standard or otherwise self-evident, this section may be absorbed into the Experimental Plan.

   These experiments will attempt to generate a “phase” diagram for H-mode regimes in local and global variables. The global parameters that will be scanned are plasma current, density, shape (triangularity), and input power. These should allow us to span a “plasma
physics” space which includes safety factor, shear, collisionality, and pressure gradient. To carry out this program with the fewest shots, we will scan RF power continuously throughout shots and vary the other parameters on a shot to shot basis.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

Toroidal Field: 5.3 T
Plasma Current: 0.7 - 1.2 MA
Working gas species: D2
Density: L-mode target = \(1.2 \sim 2.5 \times 10^{20}\) line averaged

Equilibrium configuration (if possible, refer to database equilibria): SNB, discharge development needed to access higher triangularity and effect scans

Pulse length, typical current & density waveforms, etc. Refer to database or sketch desired waveforms:

4.2 Auxiliary Systems

RF Power, pulse length, phasing: all at 80 MHz, maximum power available - needs \(\geq 4\) MW

Pellet Injection (species):
Impurity blow-off injection:
Diagnostic Neutral Beam:
Special gas puffing:
Other:

4.3 Diagnostics

List required diagnostics, and any special setup or configuration, e.g. non-standard digitization rate.

Need all high resolution edge profile and fluctuation diagnostics.

5. Experimental Plan

Both sections must be filled in.

5.1 Run sequence plan

Specify total number of runs required, and any special requirements, such as consecutive days, no Monday runs, extended run period (10 hours maximum), etc.

3 Days, both RF systems at 80 MHz
5.2 Shot sequence plan

For each run day, give detailed specification for proposed shot sequence: number of shots at each condition, specific parameters and auxiliary systems requirements, etc. Include contingency plans, if appropriate.

During each shot ICRF power will be scanned. The RF waveforms should be programmed with an initial level sufficient to obtain a steady H-mode (~ 1.5 MW) and hold for 0.2 seconds - then ramped for 0.8 seconds to the highest levels possible - all heating on axis (ie @ 80 MHz). Triangularity will be scanned shot to shot. The limits cannot be precisely stated until we gain experience with the new divertor, but the ranges will be something like 0.4-0.8 for lower triangularity and 0.2-0.7 for upper triangularity. We will need to keep the upper x-point far enough away to avoid excess power loading in that area.

For each shot with scanned ICRF power, a three dimensional matrix of triangularity, target density, and plasma current

\[ [\delta_l, \delta_u] = [0.4, 0.2], [0.5, 0.37], [0.65, 0.53], [0.8, 0.7] \] \( (\delta_{av} = 0.3, 0.43, 0.6, 0.75) \)

\[ I_P = 0.7, 0.9, 1.2 \text{ MA} \]

\[ n_e(\text{target}) = 1.2, 1.75, 2.5 \times 10^{20} \text{ line averaged} \]

Approx 36 good shots required.

6. Anticipated Results

Discuss possible experimental outcomes and implications. Indicate if the program may be expected to lead to publications, milestone completions, improved operating techniques, etc. Indicate if the experiments are intended to contribute to a joint research effort, or an external database.

By generating a phase diagram of H-mode regimes and comparing with calculations of micro- and macro-stability, we should gain significant understanding of the physics associated with transitions between the regimes.

7. References

Include references both to external and internal literature or communications which bear on this proposal. See Section 2.